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QUARTERLY PROGRESS REPORT 4

ELECTROMAGNETIC DEEP-PROBING (100-1000 KMS) OF THE EARTH'S INTERIOR FROM ARTIFICIAL SATELLITES: CONSTRAINTS ON THE REGIONAL EMPLACEMENT OF CRUSTAL RESOURCES NAS 5-26138

(E82-10044) ELECTROMAGNETIC DEEP-PROBING
(100-1000 KMS) OF THE EARTH'S INTERIOR FROM
ARTIFICIAL SATELLITES: CONSTRAINTS ON THE
REGIONAL EMPLACEMENT OF CRUSTAL RESOURCES
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TYPE II

Report Due Date: June 30, 1981
Date of Submission: September 30, 1981
Period Reported March 31, 1980 - June 30, 1981

Statement of Work

Objective

The objective of this investigation is to evaluate the applicability of electromagnetic deep-sounding experiments using natural sources in the magnetosphere by incorporating Magsat data with other geophysical data.

Approach

The investigator shall pursue the above objective through an analysis of Magsat satellite data, ground-based magnetic observations, appropriate reference field models, and other satellite data.

The objective will be pursued by seeking the optimal combination of observations which lead first to a global, and then to a regional, characterization of the conductivity of the Earth's upper mantle.

Tasks

The following tasks shall be performed by the investigator in fulfillment of the above objective:

a. Use data from Magsat satellite to constrain a long-period global "response function" for the average Earth at low latitudes over a period ranging from 6 hours to 27 days.

b. Synchronize the Magsat data with low-latitude ground-based observatory data to determine the vertical gradient of the respective magnetic field components. Use the vertical gradient of the appropriate components to independently ascertain the separation of external and internal field contributions.

c. Segregate the Magsat electromagnetic "response functions" according to the tectonic regime at the Earth's surface and evaluate systematic differences between regions having lateral scale sizes on the order of 1000 km or greater.

d. Theoretically evaluate problems of resolution and interpretation involving electromagnetic induction by temporally and spatially-varying magnetospheric sources in a rotating inhomogeneous Earth as observed at arbitrary points in space. Use these theoretical studies to constrain the interpretation of Magsat data as well as to propose further applications of satellite-based electromagnetic deep-sounding experiments.

e. Integrate the regional response functions with other geophysical data in order to constrain the joint interpretation of comprehensive physical models.

f. Prepare and submit to NASA periodic progress reports and a detailed final report documenting the results of this investigation.

Summary of Work in Progress

- I) Interactions of External Source Fields With An Earth Having Finite Conductivity. We are continuing to develop our computer program for looking at the coupling of finite-dimensional source fields with a laterally heterogeneous earth (see Quarterly Report I).
- II) Considerations In Noise-Free Estimates of Global Electromagnetic Response Functions Using Satellite Data. We are continuing to develop an algorithm for calculating a time-varying reference field using ground-based magnetic observatory data (see Quarterly Report II).

Miscellaneous

A paper was presented at the AGU meeting in Baltimore during May 1981. A copy of the abstract is attached.

Work is progressing on two papers to be presented at the Fourth Scientific Assembly of IAGA to be held in Edinburgh, Scotland during August, 1981. This meeting is to be preceded by a MAGSAT investigators meeting, for which we are preparing as well. The work to be reported on in Edinburgh is the following:

- 1) Electromagnetic Induction and Source Field Effects in MAGSAT Data.
- 2) Finite Source Fields Coupled to Lateral Conductivity Heterogeneities.

This latter study is being jointly supported through NASA and NSF-Geophysics.

Problems Encountered

We have recently discovered that ground-based standard magnetic observatory is not as available for the time of the MAGSAT mission as one might have expected. Other investigators have apparently run into the same problem. We are presently trying to determine the exact times and observatories from which data are available.

ARE THERE INDUCTION EFFECTS IN Dst CORRECTIONS
TO MAGSAT DATA?

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There is a need, when deriving residual field models from MAGSAT data, to be able to apply corrections to the data for the contribution from Dst. Unfortunately induction effects in Dst preclude in general the simple correction of the observed field by subtracting the Dst-term; one needs to account for the induced phase-shifted internal component. In addition, the temporal behavior of Dst is such that a magnetic storm with a sudden commencement has higher frequency energy at early storm-time ($T < 2$ days) and lower frequency energy at late storm-time ($2 < T < 5$ days). The result is that the ratio of internal to external fields is not a simple constant, but the amplitude of the ratio changes with time during a magnetic disturbance. Fortunately, simple model calculations indicate that during late storm-time the internal:external field ratio is essentially constant so that there is hope that quantitative correction factors can be applied to late storm-times in a straightforward way. As one attempts such a correction during earlier storm-time, the morphology of the Dst event has to be taken into account.

- 1) Spring Meeting
- 2) HERM 001477
- 3) J.F. Hermance
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Brown University
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02912
401-863-3338
- 4) GP (Geomagnetism
& Paleomagnetism)
- 5) MAGSAT SYMPOSIUM
- 6) 0
- 7) 0%
- 8) Above
- 9) C

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